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Associations between child mobile use and digital parenting style in Hungarian families

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ABSTRACT

Mobile touch screen device (MTSDs) use is becoming widespread in children and has negative and positive consequences. Yet, factors associated with greater use remain unexplored, despite the importance of their identification for intervention purposes. It stands to reason that parents can influence child MTSD use, via their attitudes, beliefs, role-modelling, and style of parenting. Here, we examined the associations between these parental characteristics and child MTSD use and whether parenting styles specifically with regard to child MTSD use exist. Hungarian parents ($N = 1283$) were surveyed about their children's digital activities, their own attitudes and beliefs regarding the child's MTSD use, and their own attachment to- and use of mobile phones. Taking a data-driven approach, distinct "digital parenting styles" were identified and these resembled general parenting styles. Findings further suggested that children spent more time with MTSD use if their parents: were more permissive, more authoritative and less authoritarian; had a lower educational level; exhibited greater attachment to their mobile phones; and had more positive attitudes towards, and attributed less harm and more benefits to, early device use. These results are the first evidence for existence of digital parenting styles and suggest that parental characteristics are potential prevention and treatment targets.

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Digital device; mobile device; touch screen; screen time; children; parenting style; parental attitude; digital parenting style

1. Introduction

Mobile touch screen device (MTSD) use is becoming increasingly widespread among children (Common Sense Inc., 2017). Children can use touchscreen devices, even before they develop advanced motor skills, as they do not need to use controllers as they do with personal computers or videogames. Consequently, children can begin MTSD use at an increasingly early age. According to a US survey, the average daily time children spend with mobile device use is almost an hour for 2–4-year-olds and 7 minutes for children under the age of 2 (Common Sense Inc., 2017). Comparable trends are apparent in Hungary (Pintér, 2016; where access to internet and use of digital technologies is comparable to the European average; Hungarian Central Statistical Office, 2017). Yet, relatively little research

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is available on early MTSD use, despite findings indicating that early use of other media (e.g., TV) has (mainly negative) effects on child development (Chonchaiya & Pruksananonda, 2008; Zimmerman & Christakis, 2005). Arguably, early MTSD use (i.e., in infancy, toddlerhood and preschool years) is likely similarly important from a developmental perspective, with potentially both negative and positive effects (e.g., Bedford, Saez de Urabain, Celeste, Karmiloff-Smith, & Smith, 2016; Li, Subrahmanyam, Bai, Xie, & Liu, 2018). As such, better understanding of the characteristics and factors that are associated with earlier or more intensive use may have implications for psychoeducation as well as prevention and intervention efforts.

1.1. Direct and indirect links between parenting and child behavior

Children's behavior, development, and socialization are supposed to be directly influenced by their microsystem (i.e., family, peers, and school; Bronfenbrenner, 1979). Especially during early developmental stages (e.g., prior to starting school), the family, and in particular the parents have perhaps the greatest influence on child behavior, relative to later developmental stages (e.g., adolescence) which are characterized by increased peer influence (Laible, Carlo, & Raffaelli, 2000). It has been hypothesized that parents directly influence child behavior via rule setting (Steinberg & Darling, 2017) and also indirectly via various other means. For example, parents play a large role in creating a home environment and different aspects of that environment promote certain behaviors and not others (e.g., whether or not there is a TV or a PC at home, if there is one in the child's bedroom). Parental attitudes and behaviors (including role-modelling) are also related to child habits and lifestyle, such as with regard to amount of physical activity (Arredondo et al., 2006) or sedentary behavior, including as a result of screen time (Xu, Wen, & Rissel, 2015). Beyond shaping and reinforcing specific behaviors, parenting also involves creation of a socioemotional environment through specific *parenting styles* that may affect child behavior (Rhee, 2008).

1.1.1. Parenting styles in the context of MTSD use

Parenting styles are strongly related to child development and outcomes (e.g., Kordi & Baharudin, 2010). Parenting styles correspond to the emotional climate in which parents raise their children (Steinberg & Darling, 2017) and can be characterized by dimensions of responsiveness/warmth (responding to the child's needs in a supportive, accepting, nurturing and involved manner) and demandingness/control (setting demands, rules, control, expectations, boundaries to integrate the child into the society; Baumrind, 1991; Spera, 2005). Four parenting styles can be formulated along these dimensions: authoritative (high warmth, high demand), permissive (high warmth, low demand), laissez-faire (low warmth, low demand) and authoritarian (low warmth, high demand).

Authoritative parenting involves high warmth, sensitivity, responsiveness and involvement, as well as high expectations and high demands for maturity and self-control from the child. Authoritative parents respect the child's opinion, but also maintain clear boundaries. They foster their demands through bidirectional communication (e.g., explanations of rules) and encouragement of independence.

Permissive parenting corresponds with high warmth but low demand. They set few rules or boundaries and do not have high expectation for maturity. They refrain from confrontations with their children, and rarely give guidance.

Parents with a laissez-faire parenting style show low warmth, responsiveness and emotional involvement, and also have low demands. They do not set rules, do not provide guidance and discipline. They make no demands for maturity, and impose few controls on their child's behavior.

Authoritarian parents are not warm and responsive. They have high maturity demands, are strict, expect obedience, and assert power. They express their expectations through orders and do not explain to their children the rationale behind these rules.

Specific parenting styles in relation to certain areas or domains of parenting may exist and these may not necessarily be the same across domains or even as general parenting styles; they may nevertheless affect children's behavior or functioning in that domain (e.g., eating behavior; Vereecken, Legtest, De Bourdeaudhuij, & Maes, 2009). With regard to media-related behaviors, parenting styles may also be expressed through levels of warmth and demandingness. Parental responsiveness/warmth may manifest in parents supporting their child's desired digital activity, e.g., letting the child watch videos or play games, helping the child engage in certain activities (e.g., launching an application) or teaching the child how to engage in such activities on their own. Parental demandingness, on the other hand, may manifest in parents controlling and setting limits over the child's digital activities or in supervising such activity. Indeed, parenting styles related to children's internet use were found to statistically predict that use in school-aged children (Valcke, Bonte, De Wever, & Rots, 2010). Children whose parents had a permissive Internet parenting style used the internet the most and those whose parents adopted an authoritarian or authoritative Internet parenting style used it the least. Similarly, stricter parental rules regarding TV watching were found to be negatively associated with children's screen time (Cillero & Jago, 2010). Neither the presence/nature of parenting styles related to children's MTSD use (digital parenting styles) nor the associations of those with children's actual use have been investigated to date. Identifying and better understanding these are timely, given the ever-growing presence of digital media in the daily lives of families and society and thus its potential to impact child development.

Digital parenting styles may not only influence the time children spend with MTSDs, but also the way they use it. For example, parents who expect maturity from the child or who are involved in their child's MTSD use may teach the child how to use the MTSD in a functional way. Alternatively, children whose parents only give them the device as a form of engagement or who restrict the use may use the MTSD for simpler activities or in a non-functional way.

The importance of parents for children's media use has been addressed in several studies on parental mediation. Parental mediation includes a set of strategies used by parents "to control, supervise or interpret media content for children" (Warren, 2001, p. 212). Previous research has suggested that use of parental mediation is associated with less overall time spent with, and less negative outcomes of media use (Gentile, Nathanson, Rasmussen, Reimer, & Walsh, 2012; Kalmus, Blinka, & Olafsson, 2015). However, the concept of a digital parenting style is broader than parental mediation as it includes amount of guidance and involvement with child digital device use. Additionally, the parenting style concept offers a dimensional view in which parental behavior can be placed along the dimensions of warmth and demandingness. This also emphasizes the emotional nature of these parenting styles rather than focusing solely on parental behavior (as in case of parental mediation).

1.1.2. *Role-modelling in the context of MTSD use*

Children learn observationally (social learning theory; Bandura, 1977) by attending to and imitating people in their surroundings. They identify with the model and take on observed behaviors, values, beliefs, and attitudes of the person. People in the immediate surrounding of the child, especially parents, can more easily become role-models for the child and role-modelling is an important aspect of parental influence (e.g., on child eating habits and obesity; Brown & Ogden, 2004). This is applicable to media consumption, as parental media use has been shown to predict child media habits (Bleakley, Jordan, & Hennessy, 2013; Lauricella, Wartella, & Rideout, 2015) especially in case of heavy parental use (Rideout, Foehr, & Roberts, 2010; Woodard & Gridina, 2000). Examples include associations between family TV time and child TV time (Cillero & Jago, 2010; Duch, Fisher, Ensari, & Harrington, 2013) or parental smartphone or tablet-use and child device use (Lauricella et al., 2015). Of note, it is not only overt parental behavior (i.e., digital device use) but also attitudes and emotions that can be modelled for children to imitate. Yet, no study focused on whether parental attachment to these devices is associated with child MTSD use to date. Furthermore, beyond role-modelling, parental media use can also influence child behavior insofar as it corresponds to less parental attention and other resources allocated to the child. For example, parents who watch more TV (Kirkorian, Pempek, Murphy, Schmidt, & Anderson, 2009) and who are heavy mobile users (Radesky, Schumacher, & Zuckerman, 2015) engage in less parent–child interaction.

1.1.3. *Other parental factors influencing child MTSD use*

1.1.3.1. Parental attitudes. Parents' attitudes toward certain activities or habits predict whether/to what extent/how their children will engage in those activities (e.g., eating behavior; Scaglioni, Salvioni, & Galimberti, 2008). Parental role-modelling, practices, rules and parenting style may all be influenced by parental attitudes (as attitudes predict behavior; Fishbein, & Ajzen, 1974). Parental attitudes toward child media use are mixed and largely depend on media type (Rideout et al., 2010): while parental attitudes toward TV use are mixed, they are more positive toward computer use (Rideout & Hamel, 2006). In turn, more positive parental attitudes toward media are associated with longer child time with those media (Cingel & Krcmar, 2013; Vandewater et al., 2007). However, to our knowledge, only two studies examined this association in case of MTSDs (Lauricella et al., 2015; Nikken & Schols, 2015; see below in the "Parental Beliefs" section). Furthermore, there is disproportionate focus on cognitive aspects of attitudes, i.e., opinions about MTSD use at the expense of focus on emotional aspects of those (Pooley & O'Connor, 2000).

1.1.3.2. Parental beliefs. Beliefs are the cognitive source of attitudes (Fishbein, & Ajzen, 1975). Parental beliefs regarding child media use (traditional and digital) – such as whether and at what age the media have negative or positive effects on the child – may influence the degree to which parents allow or encourage their children's media use, which in turn, can influence how much the child uses these devices. For example, parents who attribute positive effects to digital media engage in co-use and active mediation, whereas parents who are concerned about negative effects are more likely to restrict their child's media use (Nikken & Jansz, 2006; Nikken & Schols, 2015). In support, parents' belief that TV can be helpful is associated with increased child screen time (Vandewater et al., 2007) and parents who think that media provide a source of entertainment/relaxation and who think that it

has positive effects tend to have children who spend more time with MTSD use (Lauricella et al., 2015; Nikken & Schols, 2015). In addition to these aspects of parental attitudes and behaviors, other aspects of the microsystem within which youth function, such as socio-economic status (SES) and parental education, can also impact child habits, including screen time or MTSD use. For example, higher SES and parental education are related to less time child spent with mobile media (Common Sense Inc., 2017; though others did not find such association in a much less representative sample; Kabali et al., 2015).

Taken together, some data on the associations between parental attitudes, beliefs, and role-modelling and child media use (including MTSD use) are available, but no studies to date have focused on the existence of digital parenting styles or the associations thereof with child media use. In addition, in most studies, children's media use was measured only in terms of amount of use. However, the type of use, e.g., what kind of activities children are doing on these devices is also comparably important, as different activities (e.g., watching videos, taking photos, playing games) could have different effects on cognitive development. Additionally, the relationship between parental factors and these specific activities is also important to explore, e.g., whether certain parental attitudes are related to more advanced activities.

1.2. Aims and hypothesis

Our main aim was to reveal whether parents' *digital parenting style*, *general attitude*, and *beliefs* regarding early MTSD use and *role-modelling* as indicated by their own mobile attachment and use are associated with child digital activity indexed by the amount of time and type of activity children engage in MTSD use.

1.2.1. Exploratory research questions

To this end, we first identified types of MTSD use (and user types) in children (Exploratory Research Question 1 a, b) and investigated (Exploratory Research Question 2) whether digital parenting styles can be identified (and conceptually determine whether these correspond to general parenting styles as described by Baumrind, 1991). Following an explorative design, we relied on a data-driven analytic approach involving principal component analysis (PCA) using items selected based on high-frequency responses in an open-ended questionnaire survey.

Also exploratorily, we aimed to identify different kinds of parental beliefs regarding the potential beneficial and harmful effects of early MTSD use (Exploratory Research Question 3).

1.2.2. Hypotheses

We hypothesized that children engage in MTSD use for a greater amount of time and in a more active/advanced manner, if their parents: (H1) have a permissive digital parenting style, (H2) have a more positive general attitude toward early MTSD use, (H3) have more positive cognitive concepts or beliefs (i.e., they attribute more beneficial and less harmful effects to early use), (H4) also use their own mobile phone for greater amounts of time, and (H5) are more attached to their phone.

Variables that may have confounding effects on child MTSD use, such as parental educational level and child age and sex (Kabali et al., 2015; Lauricella et al., 2015) were accounted for.

Additionally, to the best of our knowledge, no data are available about how the age of onset of MTSD use changed over the past years and it was our aim to investigate the existence of such trends. Parents were asked to retrospectively report on when their child first engaged in MTSD use. We hypothesized (H6) that the age of onset of MTSD use has been becoming earlier, and thus that younger children are more likely to be an MTSD user by a given age than older children.

2. Method

2.1. Participants and procedure

Participants were recruited online, through Facebook and the website of a Hungarian online magazine, where the study questionnaire (*Digital Kids Questionnaire*; see below) was advertised. Parents were included if they had a child aged between 0 and 7 years. This age group was chosen because we were interested in MTSD use in early childhood (Nores & Barnett, 2010): in this age, the effects of MTSD use on development could be bigger and more long-lasting (Schoenmaker et al., 2015) and the influence of parents on their child behavior is relatively greater (Laible et al., 2000) than during later ages. Additionally, based on results of our open-ended survey (see below), we assumed that in children older than 7 years, there would be less variability in experience with MTSD use. A total of 1283 parents completed the *Digital Kids Questionnaire*; 13 were excluded due to inconsistent responding. The final sample thus consisted of 1270 parents who reported on 680 boys and 590 girls (see Table 1 for descriptive statistics). Parents with more than one child in this age group were asked to choose the child whose surname's first letter was earlier in the alphabet.

Parents who completed the questionnaire were entered into a lottery involving two drugstore vouchers (5000 HUF).

The study sample was different from the average Hungarian population (<http://www.ksh.hu>) insofar as female respondents (82.8%), those with at least a college degree (74.3%) and those living in the capital city (55.2%) were overrepresented.

Completing the questionnaire took approximately 20–30 minutes. Data collection took place between May and August of 2016.

2.2. Measure: Digital Kids Questionnaire

This questionnaire was based on the earlier open-ended survey completed by parents ($N = 96$) of children aged between 0 and 10 years. Based on open-ended survey responses, an inductive content analysis (Elo & Kyngäs, 2008) was conducted, via compilation of a code book from each unique response and creation of higher-order categories from these (if $\geq 5\%$ of the respondents gave the respective answers, a category was created). The obtained categories were then used in the *Digital Kids Questionnaire* as forced-choice (yes/no) items of the digital parenting style and parental beliefs questions.

The final version¹ was composed of questions about the following (variable names indicated with italics).

Demographics: We asked about age and sex of the child (*child age*, *child sex*), age and sex of the child's parent who completed study questionnaires (*parental age* and *parental sex*) and the highest level of education of the child's both parents (*parental education*).

Table 1. Independent and dependent variables: definitions, measurements, and descriptive statistics, where applicable/interpretable.

Variable			Measure	Min	Max	M	SD
Independent variables	<i>Child age</i>	In years		0.01	6.89	3	1.85
	<i>Child sex</i>	(girl/boy)				<i>N</i> boys = 680 <i>N</i> girls = 590	
	<i>Parental age</i>	In years		20	68	35.41	5.06
	<i>Parental sex</i>	(woman/man)				<i>N</i> women = 1052 <i>N</i> men = 218	
	<i>Parental education</i>	Variable with 6 levels: 1 = elementary school; 2 = technical school; 3 = high school; 4 = bachelor's degree/college; 5 = master's degree/university; 6 = doctoral degree/postgraduate. A mean score was computed from the two parents' educational levels, when available.		1	6	4.25	0.83
	<i>Digital Parenting Styles</i>	Variable with 16 response choices ² (based on the obtained categories of the open-ended version of the questionnaire) and an "other" option. A principal component analysis was carried out, and PCA scores were used for subsequent analyses.		N/A (principal component scores)			
	<i>Parental Mobile Use</i>	Activities of interest were: web-browsing, listening to music, watching movies or videos, reading books, editing/reading documents, reading/sending e-mails, accessing social networking sites, camera, games, chat. Parents had to rate on a 5-grade scale how frequently (from "never" to "daily") they use their phone for the activity. A total <i>Parental mobile use</i> score ($\alpha = 0.802$; good) was computed and used in analyses.		1	5	2.98	0.89
	<i>Parental Mobile Attachment</i>	Variable included four items from the Mobile Attachment Questionnaire (Konok et al., 2017), one from each subscale ³ . Parents had to rate each statement on a 5-grade-scale, based on how characteristic it was for them. A total <i>Parental mobile attachment</i> score ($\alpha = 0.742$; acceptable) was computed and used for analysis.		1	5	2.35	0.95
	<i>Parental Attitude</i>	Variable expressed as agreement with either that it is better for a child to start MTSD use "as late as possible" (negative attitude, 1 point) or "as early as possible" (positive attitude, 3 point), or with neither (neutral/mixed attitude, 2 point). This three-level ordinal variable was used in analyses.				<i>N</i> Negative attitude = 408 <i>N</i> Neutral/Mixed Attitude = 589 <i>N</i> Positive Attituded = 273	
	<i>Beliefs about harms</i> <i>Beliefs about benefits</i>	Parents were asked whether there are any harmful/beneficial consequences of early MTSD use and, if yes, what those are (with 19 ⁴ and 13 ⁵ response options, respectively, based on the obtained categories of the open-ended version of the questionnaire). For the analyses, a total <i>Beliefs about harms</i> ($\alpha = 0.803$; good) and <i>Beliefs about benefits</i> ($\alpha = 0.774$; acceptable) score was computed (but a PCA was also carried out). Responses indicating that early MTSD use has no potential harmful/beneficial consequences corresponded to a score of zero on <i>Beliefs about harms/Beliefs about benefits</i> subscale.		0 0	16 13	6.13 4.70	4.23 3.74
Dependent variables	<i>Amount of MTSD use</i>	Parents were asked about the frequency (with 8 levels) and duration (with 7 levels) of the child's MTSD use. The combination of these two data was used as a dependent variable in the analyses ⁶ (minutes/day).		0	360	13.01	30.84
	<i>Type of user</i>	Parents were asked about the activities their child engages in on the device/s (hereafter labelled "Activities"): with 33 response choices, e.g., "uses touchscreen", "plays with games", "watches movies" and an "other" option). We ran a PCA on these items, and a cluster analysis based on the PCA scores. Cluster membership was used as dependent variable in analyses.		See Supplemental Material 3 for cluster frequencies			

Characteristics of the Child MTSD Use: Parents were asked whether their child uses a tablet/smartphone regularly, and if yes, about the frequency and duration of the child's MTSD use (*amount of MTSD use*), and the typical activities the child engages in on the MTSD (*activities*).

Digital Parenting Styles: Parents were asked how they react to situations wherein the child showed interest in an MTSD device (*digital parenting style*).

Parental Role-Modelling: Questions were asked about the frequency of parental mobile use for various activities (based on Konok, Gigler, Bereczky, & Miklósi, 2016; Konok, Pogány, & Miklósi, 2017; *parental mobile use*), and about parental behavior and feeling characteristics of attachment to their mobile phones (based on Konok et al., 2017; *parental mobile attachment*).

Parental Attitude: We assessed parents' general attitude toward early MTSD use (*parental attitude*).

Parental Beliefs: We asked parents about their opinions about possible harmful and beneficial consequences of early MTSD use (*beliefs about harms*, *Beliefs about benefits*).

For the exact measurements of these questions (presented according to whether they were used as dependent or independent variables in the analyses) see Table 1.

2.3. Statistical analyses

Assumptions of statistical tests were considered prior to analyses (SPSS 22.0.0.).

Four principal component analyses (PCAs) with Varimax rotation were conducted on the Activities (Q6), Parenting styles (Q8), Beliefs about harms (Q11) and Beliefs about benefits (Q13) items, separately. Although PCA is generally suggested for continuous data, it is considered appropriate for binary data as well (Gower, 1966; Jolliffe, 2002; Vyas & Kumaranayake, 2006).

Items with a 0.4 or greater loading on a particular component were retained (Tabachnick & Fidell, 2001). Items with a 0.4 or greater loading on more than one component were considered to cross-load and removed. The number of final components was determined based on both the eigenvalues (greater than 1) and the scree plot.

A two-step cluster analysis (distance: log-likelihood, clustering: BIC) was carried out to classify children into groups on the basis of their activity types (Activities principal component scores) and amount of MTSD use. The validity of the clusters was checked using discriminant function analysis with leave-one-out cross-validation. Clusters were also compared on each predictor variable using Kruskal–Wallis tests to see what level of these variables characterise the clusters.

The association between *Parenting styles* principal component scores (independent variables; IVs) and children's *Amount of use* (dependent variable; DV) was examined using a General Linear Model (GLM) ($n = 535$; as parenting styles questions were only asked of parents of regular MTSD users). A separate GLM was carried out on the total sample ($N = 1270$) with parents' scores on the *Parental attitude*, *Beliefs about harms* total score, *Beliefs about benefits* total score, *Mobile use*, and *Mobile attachment* total scores, parental education, child age and sex as IVs and children's *Amount of use* as the DV (see Table 1 for list of IVs and DVs). For those who responded that their child does not regularly use MTSDs, the value for *Amount of use* was set to zero.

To determine the extent to which parent variables (*Parental attitude*, *Parenting styles* principal component scores, *Beliefs about harms*, *Beliefs about benefits*, *Mobile use*, *Mobile*

attachment total scores and parental education) and child variables (age and sex) as IVs are associated with child cluster membership (*Activities*, DV), an ordinal logistic Generalized Linear Model (GzLM) was estimated for the regular MTSD user subsample ($n = 535$).

All GLM and GzLM initial models included main effects but not interactions. Stepwise model selection with backwards elimination was used based on p -values.

To test whether children start using MTSDs earlier today than a few years ago, the ratio of children who had and who had not started MTSD use before their 3rd birthday (Q5) were compared between age groups using Chi-square tests (age group and MTSD use before the 3rd birthday were the categorical variables, and Chi-square tests were ran separately for mobile and tablet use). Only data of children at least 3 years old were used in the analysis. The third birthday was chosen because setting this limit at an older age (e.g., age 4), there would have been too few groups to compare (i.e., 4-, 5-, 6-, and 7-year-olds), but setting it at a younger age (e.g., 2), there would have been too few children who started MTSD use before their second birthday.

2.4. Ethical statement

This study was carried out in accordance with the Declaration of Helsinki and national and international guidelines (i.e., the Hungarian and the American Psychological Association) with written informed consent obtained from all parents (and assent from children). The study was approved by the United Ethical Review Committee for Research in Psychology (EPKEB) (reference #: 06/2017).

3. Results

3.1. Identifying types of MTSD use/users

3.1.1. Types of use (exploratory research question 1a)

For descriptive statistics on the ratio of regular MTSD users to nonusers, and regular users' average time spent with MTSD use across different age groups, see Supplemental Material 1.

The PCA of the *Activities* items indicated three components (Supplemental Material 2). Items 8, 13, 21, 26, 16, 29, 6, 15, and 28 were removed iteratively (in the listed order) due to poor or to cross-loading. The three components were interpreted as *Non-functional use* (the child uses the MTSD not for its designated functions, but as a toy or object generally, e.g., chews it or randomly pushes the buttons), *Functional-active use* (the child uses the MTSD for its designated functions, autonomously and actively, e.g., launches applications or makes calls) and *Functional-passive use* (the child uses the MTSD for its designated functions, but in a passive way, i.e., participates in an activity that is typically initiated by someone, e.g., watches videos but does not launch them). The three components together explained 45.5% of the total variance.

3.1.2. Types of users (exploratory research question 1b)

The cluster analysis indicated three clusters (Supplemental Material 3): *Beginners* (children who use the MTSD for short amounts of time and mainly for non-functional activities), *Passive/light users* (who use the MTSD for moderate amounts of time, and mainly for functional-passive activities), and *Active/heavy users* (who use the MTSD for long amounts

of time and mainly for functional-active activities). The three clusters were well distinguishable (discriminant analysis with cross-validation: 98.8% success rate) from each other based on the types of use (principal component scores) and amount of use. The three clusters differed from each other on Activities principal component scores and amount of MTSD use variables (Kruskal–Wallis tests, all $ps < 0.01$). Pairwise differences are indicated in Supplemental Material 3.

3.2. Parents' behavior and attitudes toward their child's MTSD use

3.2.1. Digital parenting styles (exploratory research question 2)

The PCA of the Parenting styles items indicated four components (Supplemental Material 4). Items 11, 12, 16 were removed iteratively (in the listed order) due to cross-loading. The four components corresponded to established parenting styles and were thus interpreted as *Permissive* (the parent not only permits the child to use the MTSD, but also shows how to use it or gives information), *Authoritative* (the parent permits the use but with some limitations/conditions), *Authoritarian* (the parent restricts/prohibits the usage or permits it only sometimes), and *Laissez-faire* (the parent permits the child to use the MTSD in order to engage him/her). The four components together explained 48.3% of the total variance.

3.2.2. Parental beliefs about potential harms and benefits of early MTSD use (exploratory research question 3)

The majority (66%) of parents agreed both with the statement that MTSD use has negative effects and the statement that it has positive effects on children.

Parents who agreed that using a tablet/smartphone in early childhood can have harmful consequences (82%, $n = 1041$), were asked in what way they believed MTSD use can potentially harm their children (see Table 1 for descriptives). The PCA on Beliefs about harms items indicated three components (Supplemental Material 5). Items 17, 6, and 15 were removed iteratively (in the listed order) due to cross-loading. The three components were: *Disturbs development* (early MTSD use disturbs/does not improve normal development/can cause problems in development), *Takes time from other things* (early MTSD use takes time and inclination away from other areas of life and/or reduces interest or motivation to engage in other developmentally typical activities) and *Danger/addiction* (early MTSD use is dangerous or can be addictive). The three components together explained 40.7% of the total variance.

Parents who agreed that using a tablet/smartphone in early childhood can have beneficial consequences (77%, $n = 981$), were asked in what way they believed MTSD use can potentially benefit their children (see Table 1 for descriptives). The PCA of Beliefs about benefits items indicated four components (Supplemental Material 6): *Openness/entertainment* (MTSD use makes the child more open to the world/new things and provides an opportunity for entertainment), *Skill-improvement* (MTSD use improves general skills), *Information/learning* (MTSD use aids learning new things/obtaining information about the world) and *Digital skills* (MTSD use improves digital skills/aids learning informatics). The four components together explained 53% of the total variance.

3.3. Associations of child and parent variables with the extent and type of child MTSD use

3.3.1. Associations of child and parent variables with amount of use

The first GLM supported *H1*: children of parents who have a permissive (parameter estimate = 4.407; SE = 1.61; Wald $\chi^2_1 = 7.490$; $p = 0.006$) or authoritative (parameter estimate = 3.848; SE = 1.61; Wald $\chi^2_1 = 5.712$; $p = 0.017$) digital parenting style, engages in more MTSD use whereas children of parents who have an authoritarian digital parenting style (parameter estimate = -8.812; SE = 1.61; $\chi^2_1 = 29.947$; $p < 0.001$) engage in less MTSD use.

The second GLM supported *H2-H5* except for *H4*: if the parent has a more positive attitude toward early MTSD use (*H2*), considers early MTSD use less harmful and more beneficial (*H3*), has higher mobile attachment (*H5*), then the child spends more time with MTSD use. Contrary to hypotheses, parental mobile use was not associated with child Amount of use in (*H4*). Regarding the confounding variables, older children and children of less-educated parents spend more time with MTSD use, but child sex was not associated with Amount of use (Supplemental Material 7).

3.3.2. Associations of child and parent variables with types of users (clusters)

Findings suggested that if the parent is higher on permissive or the authoritative digital parenting style and lower score on the authoritarian style (*H1*), if (s)he attributes more beneficial effects to early MTSD use (*H3*), is less educated and if the child is older, then the child is more likely to be a more advanced user (i.e., to belong to higher cluster). Sex of the child had no association with Amount of use. *H2*, *H4*, and *H5* were not supported as Parental attitude, parental Mobile usage and Mobile attachment were not associated with Amount of use in the child (Supplemental Material 8).

3.4. Change in the age of first MTSD use over the last years

Whether or not children started using mobile phones ($\chi^2 = 78.44$; $\Phi = 0.31$; $p < 0.001$) or tablets ($\chi^2 = 52.78$; $\Phi = 0.26$; $p < 0.001$) before their 3rd birthday depended on age groups: in support of *H6*, younger children were more likely an MTSD user by their third birthday than older children (Figure 1).

4. Discussion

4.1. Digital parenting styles and their associations with children's MTSD use

To our knowledge, the current study is the first to provide evidence for the existence of digital parenting styles and for the association between such styles and amount and type of child MTSD use. Taking an explorative approach, we identified comparable parenting styles in relation to children's MTSD use as those identified in case of internet (Valcke et al., 2010) and general (Baumrind, 1971) parenting styles.

Parents displaying a *permissive digital parenting style* allow their children to engage in MTSD use, but they are also nurturing and interactive. For example, parents with this style show their child how to use the application/device and answer the child's questions. As such, permissive digital parenting is associated with low levels of demandingness and high levels of

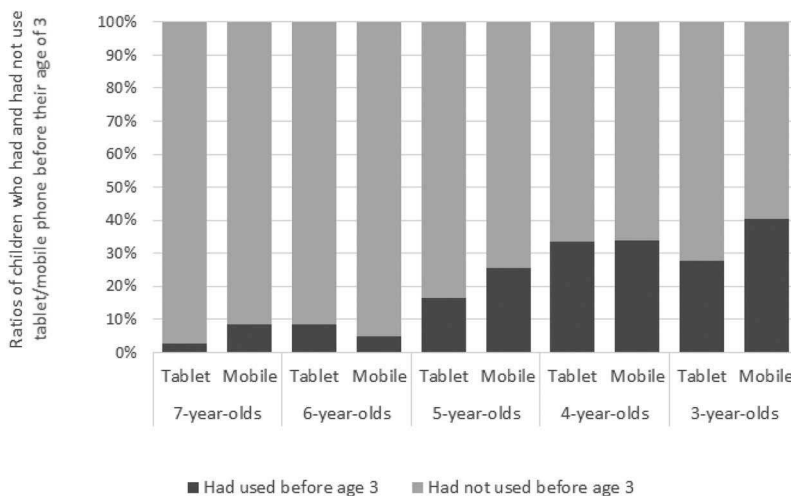


Figure 1. Ratio of children who had and had not used mobile phone/tablet before their 3rd birthday in different age groups, reported by Hungarian parents. The ratios were calculated retrospectively from parents' reports about the age when their child started to use the devices.

involvement/warmth. From the perspective of a parental mediation framework, permissive parents likely engage in active/interactive mediation (Nikken & Jansz, 2006).

Conversely, *authoritative digital parenting* refers to a parenting style where MTSD use is permitted but only under certain conditions (e.g., only after the child has attended to his/her chores and obligations) and/or with certain limitations (e.g., time limits). Authoritative digital parenting is thus characterized by high levels of demandingness and high levels of involvement/warmth. Additionally, consistent with authoritative parenting involving encouragement of child autonomy (Baumrind, 1971), parents with an authoritative digital parenting style tend to not lock the device screen when they give it to the child or strictly supervise use. Authoritative parents use some mixture of restrictive and active/interactive mediation (setting limits and conditions; Nikken & Jansz, 2006).

Parents exhibiting an *authoritarian digital parenting style* restrict/prohibit child MTSD use and this parenting style is thus associated with high levels of demandingness and low levels of involvement/warmth. Only one item that loaded strongly onto this component describes some level of parental involvement, but even this item is a combination of statements reflecting different degrees of involvement ("We do not give it to her/him, we only show it/we watch the pictures/videos together"). Therefore, authoritarian parents use restrictive mediation and supervision (Nikken & Jansz, 2006).

Parents who adopt a *laissez-faire digital parenting style* allow their children to use the device in order to engage him/her, suggesting that – at least in this context – they are not nurturing or interactive. This digital parenting style is thus characterized by low demandingness and low involvement/warmth. Laissez-faire parents do not engage in mediation.

Parenting styles are related to child development and outcomes (e.g., Kordi & Baharudin, 2010) yet little is known about the associations between digital parenting styles and child digital device use. Consistent with our hypotheses, parents' digital parenting style is associated with amount and type of child MTSD use. Furthermore, it appears that this association is driven primarily not by degree of parental demandingness, but by parental

involvement/warmth. Permissive and authoritative parenting was associated with longer durations of MTSD use and more active or advanced use in children. In case of authoritarian digital parenting, children use MTSDs for shorter durations of time and in a rather passive or non-functional way. The degree to which parents exhibited a laissez-faire style was not associated with amount of child MTSD use. This is in contrast with findings on school-aged children's internet use, whose parental demandingness (permissive and laissez-faire styles) was shown to be negatively associated with increased internet use (Özgür, 2016). However, in contrast with older children and adolescents who possess the necessary skills and knowledge to use Internet or digital devices (including MTSDs), and only need parental permission to do so, young children may need guidance and support to learn MTSD use and, as such, use them more if their parents have a warmer parenting style.

4.2. Associations of parental attitudes, beliefs, and role-modelling with children's MTSD use

As expected, the more positive attitude the parents have regarding early MTSD use, the more time the child spends engaging in such use. This result is consistent with earlier findings indicating that positive attitudes toward media were related to higher rates of child media consumption (Cingel & Krcmar, 2013).

Parental attitudes may be influenced by parents' beliefs about potential benefits and harm of early MTSD use. In the current study, the positive and negative effects parents attributed to early MTSD use were similar to those reported by Nikken and Schols (2015): it improves the child's knowledge and skills, is an entertainment opportunity, but it can also be dangerous (e.g., inappropriate content or inappropriate use, abuse by others) and developmentally inappropriate. Parents in the current sample additionally reported that a disadvantage of MTSDs is that they take time away from other activities.

In line with our hypotheses, we found that parents who attribute more benefits and less harm to early MTSD use have children who spend more time with MTSD use. This corresponds to prior data on TV and media, which suggest that parents who believe TV can be helpful have children who watch more TV (Vandewater et al., 2007) and also that parental worries about media are negatively related to child TV consumption (Cingel & Krcmar, 2013). The majority (66%) of our participants reported that they believed early MTSD use has both positive and negative effects which are also consistent with earlier findings (Radesky et al., 2016).

Additionally, we found that parents who are less educated have children who spend more time with MTSD use, consistent with what has been found with regard to child TV screen time (Hesketh, Ball, Crawford, Campbell, & Salmon, 2007). Better educated parents may be more aware of the problematic aspects of (TV or) mobile phone use and thus consider these in their parenting (Roser, Schoeni, Foerster, & Rösli, 2016). Thus, educational background may influence child MTSD use through influencing beliefs and attitudes with regard to early MTSD use.

Contrary to hypotheses and the findings of Lauricella et al. (2015) and Pempek and McDaniel (2016), amount of parental mobile use was not, but degree of parental mobile attachment was, associated with amount of child MTSD use. This may be because it is not only through their behavior but also through their attitudes and emotions that parents can be role-models for their child. Parents' higher mobile attachment may contribute to children developing positive attitudes toward MTSDs and, as their parents are also more likely to allow

device use, to children using MTSDs more frequently. From another perspective, parents who are highly emotionally involved in digital media may have less attentional resources to interact with their child, resulting in the child engaging him/herself via some other means (e.g., with MTSD use). Investigating these and other putative mediating mechanisms (e.g., role-modelling, parenting styles and practices, home environment) between parental mobile attachment and child MTSD use are important next steps for future research. Additionally, some parents may refrain from using the smartphone in front of the child, while others do not, and this may depend on their mobile attachment: those who have high mobile attachment may not be able or willing to control their mobile use in front of the child. This can explain why only parental mobile attachment, and not mobile use is associated with child MTSD use. In the future, parental mobile use should be investigated separately based on whether it occurs in front of the child or not.

4.3. Age of onset of MTSD use

Our results support the hypothesis that children are starting to use MTSDs at a younger age than was the case earlier (insofar as older children were less likely to have started MTSD use before the age of 3 than younger children). In contrast to the professional recommendations to discourage or prohibit digital media use in children under the age of 2 (American Academy of Pediatrics, 2016; 2018), more than one-third of the children between the ages of 1 and 2 in our sample were reported to have started MTSD use. Given significant neural plasticity at this age (Schoenmaker et al., 2015), the observed trend calls for increased empirical study of the various effects of early MTSD use.

4.4. Association of children's age with their MTSD use

Results show that as children get older, they spend more time with MTSD use (as in Kabali et al., 2015; Lauricella et al., 2015; Roser et al., 2016). The proportion of regular MTSD users also considerably increased with age, perhaps because MTSDs offer more opportunities for older children who have more advanced cognitive and motor capabilities: the results show that they typically use the MTSDs in a more advanced way.

4.5. Limitations and future directions

Although our findings establish important associations, our research design is not suitable for causal inferences. Of note, we cannot rule out that some variables, such as child MTSD use affects parenting style, parental attitude/belief or parental mobile attachment and not the other way around (or that there is a bidirectional effect). For example, it is possible that if the child uses MTSDs more, parents develop more positive attitude and beliefs, either because they experience positive/no negative consequences of the MTSD use or because of cognitive dissonance reduction (Festinger, 1957). Similarly, not only can parenting style influence child characteristics, but the reverse is also possible (Padilla-Walker, Carlo, Christensen, & Yorgason, 2012). Additionally, it is also possible that parent variables indirectly affect children's MTSD use. We referred to the possibility of different mediating and moderating mechanisms. These alternatives are hardly observable as experimental studies in this topic are not possible to carry out, but longitudinal studies may clarify some of these questions.

Another limitation to our study is that we observed digital parenting styles (parental reactions to child MTSD use) only in parents who reported that their child shows interest toward MTSDs. However, parents may offer MTSDs to the child even if he/she does not show interest toward it, so parents can be proactive, not only reactive in their behaviors regarding child MTSD use. This experimental consideration should be addressed in the future.

One of the strength of our study is its data-driven approach. Instead of pre-selected questions (i.e., a theory-driven approach), we explored parents' attitudes and behaviors exerting as little influence on those as possible. Nevertheless, the questionnaire will need further validation in the future.

Although a recent study showed that when people are asked about how often they use their mobile phone, the correlations are quite high between self-report and objective log-data (Boase, & Ling, 2013), parents might have distorted their responses regarding their mobile use and mobile attachment, especially given that these questions were asked after parents described their opinions, attitudes and parenting behaviors related to child MTSD use. Therefore, the order of questions may be beneficial to reverse in future studies.

Variables not assessed in this study may also be linked to child MTSD use. For example, although we measured how much the parent uses their mobile phone and to what extent they are attached to it, it would be also important to measure how much time the parent uses their mobile phone (or other devices) in front of the children.

Parental mediation techniques could be also investigated in relation to digital parenting styles, e.g., are digital parenting styles involve certain specific mediation techniques as we hypothesize above? To what extent are the two phenomena overlapping?

Additionally, a possible contribution in future studies could be to investigate whether parents' general parenting style and digital parenting style correspond or diverge. For example, is it possible that a parent has a permissive digital parenting style, but an authoritative general parenting style?

4.6. Conclusions

In conclusion, results suggest that parents may influence their children's MTSD use, through modelling behavior, digital parenting style, attitudes and beliefs about early MTSD use, and their educational level. Future studies should clarify how these variables are related, including by assessing potential mediating and moderating mechanisms, and examining whether digital parenting styles explain child MTSD use above and beyond other parental factors.

As children start to use MTSDs at an increasingly early age, and for increasing amounts of time as they get older, it is predictable that MTSD use will further intensify in children during the upcoming years. Adults exhibit attachment to their mobile devices (Konok et al., 2017) and this attachment is not only also observable but may be more pronounced in youth and this may potentially result in youth spending less time spent with other (developmentally appropriate and important) activities and toys. Thus, there is urgent need to examine possible effects of MTSD use on development. If findings indicate that early MTSD use has some negative consequences on child development, in combination with the current results, the data may suggest that a reduction in child MTSD use can be achieved via changes in their parents' attitudes and knowledge, i.e., parental education (Hinkley, Cliff, & Okely, 2015).

Notes

1. The *Digital Kids Questionnaire* is available from the first Author upon request.
2. For example, "We usually give it [i.e., the device] to him/her"; "We try to keep him/her busy with another thing (e.g., a toy)".
3. Item 1.: *If I feel uneasy/tense in company, I take out my phone.* Item 2.: *I am nervous/tense when I leave my phone at home.* Item 3.: *If my phone is in my hand, I feel more confident.* Item 4.: *If I do not have my phone on me, I do not feel safe.*
4. For example, "It can cause addiction/it is hard to put it down", "It harms the eyes", "It overstimulates the nervous system".
5. For example, "The child's knowledge increases/getting information", "It improves fine motor skills", "It opens up the child's world".
6. To calculate "*Amount of use*" we assigned numeric values to the response options (which were approximate intervals) in a way that the exact value fell in the middle of the interval (e.g., for "30–60 minutes" the value was 45 minutes). Then, we multiplied *Frequency of use* (times/day) and *Duration of use* (minutes) to obtain the variable "*Amount of use*" (minutes/day).

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